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Miscellaneous Metal Parts Coating Summary Report for Technical Support in Development of a Revised Ozone State Implementation Plan for Memphis, Tennessee

Pacific Environmental Services, Inc.
Durham, NC

Prepared for

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MISCELLANEOUS METAL PARTS COATING
SUMMARY REPORT

TECHNICAL SUPPORT IN DEVELOPMENT
OF A
REVISED OZONE STATE IMPLEMENTATION PLAN FOR
MEMPHIS, TENNESSEE

Mr. Ron McHenry - Project Officer
U.S. Environmental Protection Agency
Region IV
EPA Contract 68-02-3887
Assignment No. 13

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June 1985

DISCLAIMER

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The document presents information on emissions of volatile organic compounds (VOC) from a miscellaneous metal parts coating facility in Shelby County, Tennessee. The facility is reported to emit less than 25 tons per year of VOC. The results of the analysis are used to identify reasonably available control technology (RACT) for VOC emissions from miscellaneous metal parts coaters in Shelby County emitting or showing the potential to emit 25 tons per year or less of VOC. The following sections of the report briefly discuss emission sources, emission controls and costs, and operation of the miscellaneous metal parts coating facility. The control measures described in the document represent the presumptive norm or reasonably available control technology (RACT) that can be applied to existing miscellaneous metal parts coating facilities. Reasonably available control technology is defined as the lowest emission limit that a, ...

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TABLE OF CONTENTS

Section		Page
LIST OF TABLES		ii
1.0	INTRODUCTION AND SUMMARY	1-1
2.0	PROCESSES AND POLLUTANT EMISSIONS	2-1
	2.1 INDUSTRY DESCRIPTION	2-1
	2.2 PROCESS DESCRIPTION	2-2
	2.3 PLANT DESCRIPTION	2-2
	2.4 SOURCES OF VOC EMISSIONS	2-3
	2.5 ESTIMATE OF VOC EMISSIONS	2-4
3.0	EMISSION CONTROL TECHNIQUES	3-1
	3.1 CONTROL EQUIPMENT	3-1
	3.2 REFORMULATION	3-2
	3.3 APPLICATION METHODS	3-4
4.0	ENVIRONMENTAL ANALYSIS OF RACT	4-1
	4.1 REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT)	4-1
	4.2 AIR POLLUTION	4-2
	4.3 OTHER ENVIRONMENTAL IMPACTS	4-2
5.0	CONTROL ANALYSIS OF RACT	5-1
	5.1 HIGH SOLIDS COATING COSTS	5-1
	5.2 OTHER CONTROL METHOD COSTS	5-2
6.0	REFERENCES	6-1
APPENDIX A -	Model Regulation, Surface Coating of Miscellaneous Metal Parts and Products	A-1
APPENDIX B -	Enforcement Aspects	B-1

LIST OF TABLES

Table	Title	Page
2-1	Coating and Solvent Usage and Potential VOC Emissions in 1984 by Hunter Fan Company	2-4
3-1	Transfer Efficiencies for Surface Coating	3-5
4-1	VOC Emissions Resulting From Use of Solids Coatings	4-3
5-1	RACT Costs for Hunter Fan Company	5-3
5-2	Incremental Costs of Solvent Emission Control Options for Conveyorized Single-Coat Operation, Spray Coat Application	5-4

1.0 INTRODUCTION AND SUMMARY

This document presents information on emissions of volatile organic compounds (VOC) from a miscellaneous metal parts coating facility in Shelby County, Tennessee. This facility is reported to emit less than 25 tons per year of VOC. The results of this analysis are used to identify reasonably available control technology (RACT) for VOC emissions from miscellaneous metal parts coaters in Shelby County emitting or showing the potential to emit 25 tons per year or less of VOC. Information presented in this document was obtained from the Hunter Fan Company in Memphis, Tennessee, the Memphis and Shelby County Health Department permit application files, the 1985 Shelby County VOC emissions inventory, and the Control Techniques Guideline (CTG) Document for the Surface Coating of Miscellaneous Metal Parts and Products.[1] The following sections of this report briefly discuss emission sources, emission controls and costs, and operation of the miscellaneous metal parts coating facility.

The control measures described in this document represent the presumptive norm or reasonably available control techology (RACT) that can be applied to existing miscellaneous metal parts coating facilities. Reasonably available control technology is defined as the lowest emission limit that a particular source is capable of achieving by application of a control technology that is reasonably available considering technological and economic feasibility. It may require technology that has been applied to similar, but not necessarily identical, source categories. It is not intended that extensive research and development be conducted before a given control technology can be applied to a source. However, short-term evaluation programs are considered an appropriate technology forcing aspect of RACT. The measures considered include: (1) use of add-on control equipment, (2) use of reformulated coatings, and (3) improved application methods.

Based on the analysis of Hunter Fan Company, RACT for miscellaneous metal parts coating facilities emitting or showing the potential to emit less than 25 tons per year of VOC is 0.36 kg of VOC per liter (3.0 lbs of VOC per gallon) of coating (less water) as applied. This is the emission level recommended in the CTG. Most small miscellaneous metal parts

coating facilities can meet this emissions limit without significant cost through the use of compliant coatings. These compliant coatings are available for an increasing number of metal substrates in an increasing number of finishes. In addition, significant emission reductions can be achieved through the use of improved coating methods (discussed in Section 3.3). Other controls, such as incinerators or carbon adsorbers (discussed in Section 3.1), are not cost effective due to the low concentration of VOC in curing oven exhaust and application and flashoff ventilation.

2.0 PROCESSES AND POLLUTANT EMISSIONS

2.1 INDUSTRY DESCRIPTION[1]

A wide variety of metal parts and products are coated for decorative or protective purposes. These are grouped into hundreds of small industrial categories. The geographic distribution of these industry categories is market-dependent. For example, large farm machinery industry is located primarily in agricultural areas of the country, while other small appliances may be scattered throughout the country. Some facilities manufacture and coat metal parts, then assemble them to form a final product to be sold directly for retail. Others, called "job shops," manufacture and coat products under contract. The metal parts are then shipped to the final product manufacturer to be assembled with other parts into a product. The size of metal coating facilities and their mode of operation vary greatly. Two facilities coating the same product may apply different coatings using different application methods. The size of a facility is dependent upon the number of coating lines, size of parts or products to be coated, method of coating application and number of coats applied. The types of coating operations used include dip, spray, flow, or roll coat.

Coatings are critical constituents of the metal coating industry. Coatings must protect the metal from the atmosphere in which it will be used. For example, coatings may serve to protect metal parts from exposure to sunlight, extreme temperature, abrasion, and corrosive chemicals. In many instances, coatings must also provide the final products with aesthetic appeal. A wide variety of coatings are applied by the miscellaneous metal parts coating industry. Both enamel (containing 30 to 40 volume percent solids) and lacquers (containing 10 to 20 volume percent solids) are used although enamels are more common. Coatings are often shipped by the manufacturer as a concentrate and thinned prior to application. Both enamel and lacquer coatings may be comprised of alkyds, acrylics, epoxies, polyesters, vinyls, silicones, plastisols, and phenols. Most coatings contain several solvents. Typical solvents include ketones, esters, alcohols, aliphatics, ethers, aromatics, and terpenes.

2.2 PROCESS DESCRIPTION[1]

In a typical metal parts coating facility, the metal substrate is cleansed to remove grease, dust, mill scale, or corrosion. The coatings are then applied to the metal surface. Spraying is the more common method of applying coatings for single coat operations, with flow coating and dipping also used. For 2 coat operations, the primers are more likely to be applied either by flow or dip coating while the topcoats are almost always sprayed.

Flow coatings are applied in an enclosed booth. Metal parts are conveyed into the booth. Inside, a series of nozzles shoot out streams of coating which flow over the part. The excess coating drains into a holding tank for reuse. The coated parts are often conveyed through a flashoff tunnel to evaporate solvent and allow the coating to flow completely. Flow coating provides about a 90 percent transfer efficiency. This means that 90 percent of the coating applied to the part remains on the part.

Coatings may also be applied by dipping. The metal parts are briefly immersed either manually or by conveyor into a tank full of coating. Excess coating is allowed to drip from the part into the coating tank. Dipping provides about a 90 percent transfer efficiency.

Spraying is the most common technique for applying single coat, some primer, and most topcoat applications. Spray coating is performed in a booth to control overspray and to minimize contamination. Spraying provides a transfer efficiency of 40 to 70 percent. Electrostatic spraying is commonly used to increase the transfer efficiency to 70 to 90 percent. Transfer efficiencies vary with the part being coated and, if manually applied, the skill of the operator. Touch-up spraying of assembled parts is usually performed manually.

After coating and flashoff, parts are baked in single or multipass curing ovens at temperatures of 150 to 230°C (275-450°F). The ovens serve to dry or cure the coating.

2.3 PLANT DESCRIPTION [2-5]

The Hunter Fan Company in Memphis manufactures metal fans. The facility produces about 1200 completed fans per day, each fan containing 9 separate cast iron parts that are coated. The major

amount of coating applied at the facility is accomplished in an "Omega" spray booth equipped with a single automatically operated Ransburg® electrostatic spray gun. Overspray from the booth is exhausted out the bottom of the booth and ducted to the facility roof where the exhaust gases release to the atmosphere at 60.9 m^3/min (2,150 acfm) at ambient temperature. Following electrostatic spray, the coated parts are cured in an oven at 180°C (360°F). Exhaust gases from the oven exit via a 1 meter (39.25 inch) diameter vent at 24 m^3/min (840 acfm).

Adjacent to the Omega spray booth is a second spray booth used to "touch up" coated parts, typically, one day a month. Coating is applied in this touch-up booth by a conventional manually operated air-spray gun and air dried. Although coatings are only applied periodically, the spray booth is exhausted continuously with an air flow of 500 m^3/min. (17,700 acfm)[3].

A second touch-up booth located at the assembly area is used to repair scratched parts. An "air brush" is used to refinish minor blemishes. The air brush holds about 0.24 liters (1/2 pint) of coating. The booth operates with an air flow of 370 m^3/min. (13,000 acfm).

In a fourth spray booth, a thin black coating is applied with an air spray gun to motor armatures and air dried. The armature coating spray booth operates daily and exhausts 500 m^3/min. (17,700 acfm).

2.4 SOURCES OF VOC EMISSIONS

VOC emissions result from the evaporation of solvents contained in (and added to) the coating and the evaporation of solvents used for cleanup and housekeeping. Approximately 20 to 30 percent of the emissions from a spray coating line occur from the curing oven; whereas, 70 to 80 percent are emitted in application and flashoff.[1] Emissions from spray booths and curing ovens are vented independently to the facility roof where they release to the atmosphere.

2.5 ESTIMATE OF VOC EMISSIONS

Emissions of VOC from Hunter Fan Company are estimated based on the solvent content and the amount of coatings used in 1984.[6] Information on coating and solvent usage and potential VOC emissions is presented in Table 2-1. The total plantwide emissions are estimated at 18.9 Mg/yr (20.8 tons/year).

Table 2-1. COATING AND SOLVENT USAGE AND POTENTIAL VOC EMISSIONS IN 1984 BY HUNTER FAN COMPANY[a]

Type of Coating or Organic Solvent	Percent Organic Volatiles, Wt %	Total Density, g/l (lbs/gal)	Usage Rate, l/yr (gal/yr)	VOC Emissions,[b] Mg/yr(tons/yr)
Cleaning Solvent	100	1,147.9 (9.58)	416 (110)	0.48 (0.53)
Lacquer Thinner	100	838.8 (7.00)	4,580 (1,210)	3.85 (4.24)
Enamel Thinner	100	873.5 (7.29)	6,454 (1,705)	5.63 (6.21)
Flat Black Lacquer	71.5	946.6 (7.90)	1,862 (492)	1.26 (1.39)
Brown Enamel	52.1	1,067.7 (8.91)	4,387 (1,159)	2.44 (2.69)
Black Enamel	53.63	1,018.5 (8.50)	1,109 (293)	0.61 (0.67)
White Enamel	48.65	1,127.6 (9.41)	3,502 (925)	1.92 (2.12)
White Polyacrylic Enamel	43.21	1,201.9 (10.03)	2,290 (605)	1.19 (1.31)
Brown Polyacrylic Enamel	46.26	1,161.1 (9.69)	1,658 (438)	0.89 (0.98)
Low Gloss White Polyacrylic Enamel	43.47	1,201.9 (10.03)	1,226 (324)	0.64 (0.71)
			TOTAL	18.9 (20.8)

[a] From Reference 6.

[b] Calculated as: (percent organic volatiles) x (total density, g/l) x (usage rate, l/yr) x (10^6g/Mg) = VOC emissions, Mg/yr

3.0 EMISSION CONTROL TECHNIQUES

This chapter presents control methods available to reduce VOC emissions from miscellaneous metal parts coating operations such as that found at Hunter Fan. In general, three types of control are avaliable: (1) use of add-on control equipment, (2) use of reformulated coatings, and (3) improved application methods. These techniques are discussed below.

3.1 CONTROL EQUIPMENT

The use of add-on control equipment to reduce VOC emissions relies upon a closed vent system to capture and transport VOC emissions to a control device. Emissions capture can be accomplished by hooding installed over the area of coating applications and by using a fan to draw fumes and transport them to a control device. Spray booths typically collect vapors from coating applications and vent them out of the work area to the facility roof. Two control devices, carbon adsorption and incineration, are discussed below. Additional technical details on the use of these equipment control techniques may be found in references 7 and 8.

3.1.1 Carbon Adsorption

Carbon adsorption may be a feasible control option for reducing emissions of VOC from miscellaneous metal parts coating from the application and flashoff areas of the coating process, although there are no known installations in miscellaneous metal parts coating facilities. Particulate control measures such as dry filters or water wash curtains may be necessary upstream of a carbon adsorption unit to prevent contamination of the carbon bed. Particulate and condensible matter from volatization and/or degradation of resins can coat the carbon adsorber bed and reduce control efficiency. Carbon adsorption is not a feasible control method for curing oven exhaust gases unless the gases are cooled to 40°C (104°F) or lower before entering the adsorbers. The use of carbon adsorption can reduce captured VOC emissions by 90 percent.[1]

3.1.2 Incineration

Captured emissions from exhaust ovens, spray booths, and flashoff ovens may be controlled through incineration. For dilute gas streams

(i.e., VOC concentrations below the lower explosive limit) such as miscellaneous metal parts coating facilities, a catalytic incinerator might be a favorable choice over a thermal incinerator. The catalysts increase the rate of oxidation, allowing the reaction to occur at lower temperature than thermal incineration. Hence, catalytic incineration would minimize supplemental fuel required to sustain combustion. The feasibility of catalytic incineration for miscellaneous metal parts coating vents may, nevertheless, be limited by the heat content of the exhaust gases (i.e., Btu/scf) to be treated. Catalytic incineration would not be technically feasible, however, if certain contaminants are found in the exhaust streams. Accumulation of particulate matter, condensed VOC's, or polymerized hydrocarbons on the catalyst can block the active sites and reduce its effectiveness. Also, catalysts can be contaminated and deactivated by compounds containing sulphur, bismuth, phosphorous, arsenic, antimony, mercury, lead, zinc, tin, or halogens. If the catalyst is "poisoned," VOC's will pass through unreacted or only partially oxidized. Catalytic incineration can achieve 98 percent VOC emission reductions.[8]

3.2 REFORMULATION[1]

Significant reductions of VOC emissions can be achieved through the use of coatings formulated with reduced levels of VOC. This section briefly discusses three approaches to coating reformulation: (1) waterborne coatings, (2) higher-solids coatings, and (3) powder coatings.

3.2.1 Waterborne Coatings

The application of waterborne coatings is similar to organic solvent-based coatings. Thus, conversion to a waterborne coating does not necessarily require extensive replacement of the existing coating equipment. A reduction of 60 to 90 percent in organic emissions may be achieved by switching to waterborne coatings. The actual reduction will depend upon the composition of the original solvent-based coating, the composition of the waterborne replacement coating, relative transfer efficiencies, and relative film thickness required. Although water is the major carrier, some organic solvents are included in waterborne coatings to temper the evaporation rate, provide the coating with desired properties, and provide film coalescence. Some small appliance manufacturers have converted their electrostatic spray and dip lines to

apply waterborne coatings. Waterborne coatings are applied by flow coating, dipping, and both electrostatic and conventional spraying methods. One coating supplier said that waterborne coatings do not work well with electrostatic application because the water contained in the coating can short out the application device.[9]

3.2.2 Higher-Solids Coatings

The reduction in VOC achieved by converting to higher solids-containing coatings ranges from 50 to 80 percent. Coatings containing 45 to 60 volume percent solids have been applied by roll coating or spray technology, either with automated electrostatic techniques or manually. The use of high solids coatings would eliminate the current practice of periodically adding solvents to "thin" coatings. Hence, elimination of thinning solvents would achieve VOC reduction. Due to the higher viscosity of high-solids coatings, additional mechanical, thermal, or electric energy may be necessary for pumping and adequate atomization. Transfer efficiencies with high-solids coatings are often better than with conventional solids coatings, particularly with electrostatic sprays.

3.2.3 Powder Coatings[1]

Powder coatings have been applied as a single coating on small appliances and other miscellaneous metal parts. Powder coatings are applied either by electrostatic spray or dipping. After application of the coating, the metal part is moved to an oven where the powder particles melt and flow to form a continuous, solid film. Although powders are essentially 100 percent solids, they can release about 0.5 to 2.5 weight percent VOC due to unblocking and crosslinking reactions during curing.

Although different application equipment is necessary, powder coatings may be applied by electrostatic spray using the same application technique as for solvent-based coatings. Powder coatings may be applied in spray booths smaller than those used for conventional coatings. As a result, the air requirements necessary for adequate ventilation may be greatly reduced. Thus, the use of powders may not only conserve space but also reduce the energy required to heat the spray booth make-up air during winter months.

Changing colors with powder coatings requires that color contamination be avoided. This requires greater downtime for cleaning than conventional or waterborne coatings. Although curing temperatures necessary for powder coatings are higher than for conventional coatings, powders do not require a flashoff zone and air flow through the curing ovens can be reduced since little or no solvent is present.

3.3 APPLICATION METHODS

Although not discussed in the miscellaneous metal parts CTG[1] as a control technique, a third approach to reducing emissions of VOC is through use of improved coating application methods. Table 3-1 presents relative transfer efficiencies for surface coating large appliances using various application methods. The transfer efficiencies reported range from 40 percent, for conventional air-atomized spray, to 95 percent for electrodeposition. The use of some airless (and air-assisted airless) spray equipment have reportedly improved transfer efficiencies than those cited in Table 3-1 when used in other industrial coating processes.[11,12] The transfer efficiency of any specific technique is dependent, in part, upon the object coated and operator skill. Emissions of VOC can be effectively reduced by switching from one application method to another that achieves higher transfer efficiency.

Table 3-1. TRANSFER EFFICIENCIES FOR SURFACE COATING[a]

Application Method	Transfer Efficiency[b]
Air-atomized spray	0.40
Airless spray	0.45
Manual electrostatic spray	0.60
Flow coat	0.85
Dip coat	0.85
Non rotational automatic electrostatic spray	0.85
Rotating head automatic electrostatic spray	0.90
Electro deposition	0.95

[a] Reference 10.
These transfer efficiencies are presented for relative comparison. Actual transfer efficiencies vary from product to product and from plant to plant and are dependent upon the shape of the object being coated, operator skill, etc.

[b] Transfer efficiency means the ratio of the amount of coating solids deposited onto the surface of the coated part to the total amount of coating solids used.

4.0 ENVIRONMENTAL ANALYSIS OF RACT

This chapter discusses the environmental impacts that would result from implementing reasonably available control technology (RACT) at the Hunter Fan Company, which is presented in Section 4.1. The primary emphasis is a quantitative assessment of VOC emissions in the absence of RACT (baseline emissions) and after implementation of RACT. These impacts upon air pollution are presented in Section 4.2. Other environmental impacts are presented in Section 4.3.

4.1 REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT)

Reasonably available control technology for surface coating of miscellaneous metal parts and products consists of the recommended emission limits for coatings presented in the CTG[1] for all plants with no emissions de minimis exemption for small plants.

The RACT options identified in the CTG for conveyorized single-coat lines similar to Hunter Fan are:

(1) Use of higher solids coatings (60 percent or above),
(2) Use of waterborne coatings,
(3) Powder deposition,
(4) Carbon adsorption,
(5) Thermal incineration, and
(6) Catalytic incineration.

Of the RACT options indentified, the use of high solids coatings appear applicable to the Hunter Fan Company. These coatings are available and have the same characteristics as the conventional coatings currently used by the company.[9] Waterbourne coatings were not considered to be reasonable for use at Hunter Fan Company because these are not yet demonstrated to work well with electrostatic equipment and may impart a poorer quality finish.[9,13] Incineration (both thermal and catalytic) and carbon adsorption are not considered applicable to Hunter Fan due to cost (see Chapter 5). Powder deposition also was not considered applicable due to the cost of replacing existing equipment to allow use of the coating technology.

4.2 AIR POLLUTION

High solids coatings comparable to the coatings presently used by Hunter Fan Company have a VOC content of 0.31 to 0.36 kg of VOC per liter (2.6 to 3.0 lbs of VOC per gallon) of coating less water.[9] A conservative estimate of potential emissions reductions can be calculated assuming that Hunter Fan Company converted their coating usage from conventional to high solids coatings with a VOC content of 0.36 kg of VOC per liter (3.0 lbs per gallon) less water. High solids coatings have twice the coverage of conventional coatings, therefore, coating consumption would decrease by half. In calculating the emission reductions achieved by converting to high solids coatings, it was assumed that solvent usage for cleaning would not change. However, the use of solvents to "thin" coatings can be eliminated.[14] Table 4-1 shows an estimate of VOC emissions at Hunter Fan, assuming the facility utilizes high solids coatings.

A comparison of VOC emissions based on conventional coatings from Table 2-1 and based on high solids coatings from Table 4-1 shows that Hunter Fan Company could reduce VOC emissions by 15.5 Mg/year (17.1 tons/year) from 18.9 Mg/year (20.8 tons/year) to 3.4 Mg/year (14.2 tons/year) by converting to high solids coating.

4.3 OTHER ENVIRONMENTAL IMPACTS

Implementation of RACT would not result in any adverse environmental impacts upon water pollution or solid waste. Use of higher-solids coatings may, however, require additional energy. Due to the higher viscosity high solids coatings, additional energy may be necessary for pumping and adequate atomization, or to heat the coatings to lower their viscosity.[14]

Table 4-1. VOC EMISSIONS RESULTING FROM USE OF HIGH SOLIDS COATINGS

Type of Coating or Solvent	VOC Content[a] g/l (lb/gal)		Usage Rate[b] l/yr (gal/yr)		VOC Emissions Mg/yr (tons/yr)	
Cleaning Solvent	1,147.9	(9.58)	416	(110)	0.48	(0.53)
Lacquer Thinner	838.8	(7.00)	0	0	0	0
Enamel Thinner	873.5	(7.29)	0	0	0	0
Flat Black Lacquer	359.5	(3.0)	931	(246)	0.34	(1.39)
Brown Enamel	359.5	(3.0)	2,196	(580)	0.79	(2.69)
Black Enamel	359.5	(3.0)	556	(147)	0.20	(0.67)
White Enamel	359.5	(3.0)	1,753	(463)	0.63	(2.12)
White Polyacrylic Enamel	359.5	(3.0)	1,147	(303)	0.41	(1.31)
Brown Polyacrylic Enamel	359.5	(3.0)	829	(219)	0.30	(0.98)
Low Gloss White Polyacrylic Enamel	359.5	(3.0)	613	(162)	0.22	(0.24)
				TOTAL	3.4	3.7

[a] Assumes no change in cleaning solvent usage from that reported in Table 2-1, all coatings are high solids compliant coatings, and use of solvent for thinning coatings would be eliminated.

[b] Values reported are 1984 usage rates from Table 2-1 for solvents and one-half the usage rates for coatings reported in Table 2-1 due to the higher solids content of the compliant coatings.

5.0 CONTROL COST ANALYSIS OF RACT

This chapter discusses the costs incurred by small miscellaneous metal parts coating plants like Hunter Fan Company as a result of implementing RACT. Section 5.1 presents costs associated with switching to high solids content coatings and Section 5.2 presents a brief discussion of other control options discussed in Chapter 3.0 of this document. All costs are presented in May 1985 dollars.

5.1 HIGH SOLIDS COATING COSTS

The basis for estimating the costs for implementing RACT at small miscellaneous parts coating plants is based on the use of high solids content coatings. The costs associated with converting the Hunter Fan Company to using high solids content coatings are presented in Table 5-1. Capital costs incurred by the facility would include the purchase and installation of a heater to reduce the viscosity of high solids coatings prior to application. Heating units range in price from about $600 to $700. Installation of the heater would simply involve mounting and wiring the heating unit. For the purpose of estimating costs of implementing RACT at Hunter Fan Company; two heating units are included in the cost analysis, one for each of the spray booths used to coat fan parts on a daily basis. Capital costs would also include initial (one-time) costs incurred to adjust spray equipment and to train operators. Some startup assistance, however, would likely be provided by the coating supplier technical service personnel.[14] Total installed capital costs are estimated at $3,060.

Annualized costs associated with conversion to high solids coatings at Hunter Fan Company are estimated to provide a net cost savings to the company. The annualized costs include: (1) capital recovery costs; (2) costs associated with purchase of high solids coatings; and (3) cost savings resulting from elimination of the need to purchase enamel and lacquer thinners. The cost of high solids coatings applicable to miscellaneous metal parts ranges from about $3.17 to $3.96 per liter ($12 to $15 per gallon). These coating costs may be twice as much as conventional coatings,[14] however, their additional cost is offset because

on a per unit volume, high solids coatings can cover twice the surface area of conventional coatings (due to the greater amount of solids per unit volume).[9] Additionally, use of high solids coatings eliminates the need for thinning solvents. Based on the Hunter Fan Company thinning solvent usage (from Table 2-1), this represents an annual savings of $7,300. Net annualized costs for implementation of RACT are estimated at a cost savings of $6,800.

5.2 OTHER CONTROL METHOD COSTS

Costs developed in the CTG for controlling VOC emissions from miscellaneous metal parts coating facilities are shown in Table 5-2.[1] These costs, in 1977 dollars, show that add-on controls, such as thermal or catalytic incinerators and carbon adsorbers, do not have a reasonable cost compared to process modifications. Process modifications would include use of waterborne, high solids, and powder coating. According to the plant engineer and also the coating supplier, waterborne coatings do not perform well when applied to cast iron parts and may also cause shorting with electrostatic spray equipment.[9,13] For these reasons, only those costs associated with Hunter Fan Company converting to high solids coatings were considered.

TABLE 5-1. RACT COSTS FOR HUNTER FAN COMPANY

Cost Item	May 1985 Dollars
CAPITAL COST	
Purchased Equipment[a]	1,400
Training Cost[b]	830
Installation Cost[c]	830
Total Installed Capital Cost	3,060
ANNUALIZED COST	
Capital Recovery Cost[d]	500
High Solids Coatings[e]	0
Elimination of thinning solvents[f]	(7,300)
Net Annualized Cost	(6,800)

(xx) = Cost savings

[a]Based on purchase of two heating units at cost of $700 each. Reference 14.

[b]Estimated based on 4 labor hours for 8 operators at a labor cost of $26/hr (including overhead) for training. Assumes technical service from coating supplier provided at no additional charge.

[c]Estimated based on two workers requiring 8 labor hours per heating unit. Labor rate estimated at $26/hr (including overhead).

[d]Capital recovery cost = capital recovery factor (CRF) x total installed capital cost. Based on 10 years and 10 percent interest, CRF = 0.163.

[e]The incremental cost of high solids coatings ($/liter) would be offset by the incremental increase in the surface area cover per equivalent volume high solids coating. Reference 9.

[f]Elimination of 1,210 gallons/yr lacquer thinner at $2.50/gallon and 1,705 gallons/yr enamel thinner at $2.50/gallon. The credit assumed for elimination of lacquer and enamel thinner is based on Hunter Fan Company estimate, Reference 3. Distributor estimates were reported at $2.75/gallon enamel thinner and $3.00/gallon lacquer thinner, Reference 13.

Table 5-2. INCREMENTAL COSTS OF SOLVENT EMISSION CONTROL OPTIONS FOR CONVEYORIZED SINGLE-COAT OPERATION, SPRAY-COAT APPLICATION

(Mid-1977 thousand dollars)

Cost item	Applicable control option																	
	Waterborne coatings source size[a]			High solids coatings source size			Powder deposition source size			Carbon adsorption and thermal incineration with 35% primary heat recovery[b] source size			Carbon adsorption and catalytic incineration with 35% primary heat recovery[b] source size			Thermal incineration with 90% primary heat recovery[c] source size		
	small	medium	large	small	medium	large	small	medium	large	small	medium	large	small	medium	large	small	medium	large
• Capital investment	12	20	28	30	43	59	56	76	101	380	698	971	369	648	957	220	918	1713
• Annual costs (credits)[d]																		
Material	2	9	19	3	16	32	13	71	142	0	0	0	0	0	0	0	0	0
Electricity	0	0	1	0	0	0	0	0	0	2	9	17	2	9	17	1	6	12
Fuel	0	(2)	(3)	0	(1)	(3)	0	(2)	(3)	8	10	12	2	4	6	16	70	130
Maintenance	1	1	1	1	2	3	3	3	5	17	31	44	16	31	43	10	41	77
Capital charges	2	4	5	6	8	11	10	14	19	76	140	195	72	136	190	44	184	343
• Total annualized cost (credit)	5	12	23	10	25	41	26	86	163	103	190	268	92	180	256	71	301	562
• Solvent emissions controlled, Mg/yr	8	41	82	7	36	72	9	46	93	8	41	81	8	41	81	8	44	88
• Emission reduction, %	80	80	80	70	70	70	90	90	90	79	79	79	79	79	79	85	85	85
• Cost effectiveness (credit), $/Mg of solvent controlled	625	293	280	1429	695	597	2889	1870	1753	12875	4634	3309	11500	4390	3161	8875	6841	6386

[a] See table 3-2 for source sizes.

[b] Carbon adsorption on spray-coat booth and incineration with 35 percent primary heat recovery on drying oven.

[c] Thermal incineration with 90 percent primary heat recovery on spray-coat booth and drying oven.

[d] Increments of waste disposal costs, labor costs, and labor overhead are insignificant; these are not included in the annual costs.

6.0 REFERENCES

1. OAQPS Guideline Series - Control of Volatile Organic Emissions from Existing Stationary Sources - Volume VI: Surface Coating of Miscellaneous Metal Parts and Products. U.S. Environmental Protection Agency. EPA-450/2-78-015. June 1978.

2. Letter and attachments from Thomas Zavodny, Memphis and Shelby County Health Department to George Bernstein, Pacific Environmental Services. Process information for Hunter Fan Company. March 18, 1985.

3. Telecon. Tom Rhoads, Pacific Environmental Services, Inc., with Chris Buckenrith, Hunter Fan Company. Plant Information. May 6, 1985.

4. Telecon. Tom Rhoads, Pacific Environmental Services, Inc., with Tom Zavodny, Memphis Shelby County Health Department. Hunter Fan Company Operating Permit Information. May 30, 1985.

5. Telecon. Tom Rhoads, Pacific Environmental Services, Inc., with Alan Mitchell, Hunter Fan Company. Plant Information. June 5, 1985.

6. Memphis Shelby County, VOC Emissions Inventory Point Source Questionnaire. April 15, 1985.

7. OAQPS Guideline Series - Control of Volatile Organic Emissions from Existing Stationary Sources - Volume I: Control Methods for Surface Coating Operations. U.S. Environmental Protection Agency. EPA-450/2-76-028. November 1976.

8. Chemical Processing Plants. Pacific Environmental Services, Inc. Summary Report - Technical Support in Development of a Revised Ozone Implementation Plan for Memphis, Tennessee. EPA Contract No. 68-02-3887, Assignment No. 13. June 1985.

9. Telecon. George Bernstein, Pacific Environmental Services, Inc. with Steve Willis and Jim West, Enmar Finishes. Discussed availability, applicability and cost of compliant finishes. April 24, 1985.

10. U.S. Environmental Protection Agency. Code of Federal Regulations. Title 40, Chapter 1, Subchapter C, Part 60, Subpart SS. Washington, D.C. Office of the Federal Register. July 1, 1983.

11. Surface Coating Large Aircraft. Pacific Environmental Services, Inc., Summary Report - Technical Support in Development of a Revised State Implementation Plan for Birmingham, Alabama. EPA Contract 68-02-3887, Assignment No. 5. November 28, 1984.

12. Wood Furniture Coating. Pacific Environmental Services, Inc. Summary Report - Technical Support in Development of a Revised Ozone State Implementation Plan for Memphis, Tennessee. EPA Contract No. 68-02-3887, Assignment No. 13. June 1985.

13. Telecon. Tom Rhoads, Pacific Environmental Services, Inc., with Hutchinson, Enmar Finishes. Use of enamel and lacquer thinners. May 6, 1985.

14. Telecon. George Bernstein, Pacific Environmental Services, Inc., with Alan Mitchell, Hunter Fan Company. Discussed coating supplier, availability of compliant coatings, and touch-up booth usage. April 24, 1985.

15. Telecon. Tom Rhoads, Pacific Environmental Services, Inc., with Albert Hutchinson, Enmar Finishes. High Solids Coatings. May 3, 1985.

APPENDIX A. MODEL REGULATION

1200-3-18-.21 SURFACE COATING OF MISCELLANEOUS METAL PARTS AND PRODUCTS

(1) For the purpose of this rule, the following definitions apply:

(a) "Air dried coating" is a coating which is dried by the use of air or forced warm air at temperatures up to 90°C (194°F);

(b) "Clear coating" is a coating which lacks color and opacity or is transparent and uses the undercoat as a reflectant base or undertone color;

(c) "Extreme performance coating" is a coating designed for extreme environmental conditions;

(d) "Extreme environmental conditions" is exposure to outdoor conditions most all of the time, temperatures consistently above 95°C, detergents, abrasive and scouring agents, solvents, corrosive atmospheres, or similar environmental conditions.

(e) "Coating operation" includes all equipment which applies, conveys, and dries a surface coating, including, but not limited to, spray booths, flow coaters, flashoff areas, air dryers and ovens.

(f) "Top coating" includes all coatings other than prime coatings.

(2) No owner or operator of a coating operation subject to this rule may cause, allow, or permit the discharge into the atmosphere of any volatile organic compounds from that operation in excess of the following, except as provided for in Rules 1200-3-18-.04 or .42 or Paragraph (7) of this rule:

(a) 0.52 kg/l (4.3 lb/gal) of coating, excluding water, delivered to a coating applicator in a clear coating operation,

(b) 0.43 kg/l (3.5 lb/gal) of coating, excluding water, delivered to a coating applicator in an air dried coating operation,

(c) 0.43 kg/l (3.5 lb/gal) of coating, excluding water, delivered to a coating applicator in an extreme performance coating operation, or

(d) 0.36 kg/l (3.0 lb/gal) of coating, excluding water, delivered to a coating applicator in all other coating operations.

(3) If more than one emission limitation in Paragraph (2) applies to a specific coating operation, then the least stringent emission limitation shall be applied.

(4) This rule applies to surface coating of the following miscellaneous metal parts and products:

(a) Large farm machinery (harvesting, fertilizing and planting machines, tractors, combines, etc.);

(b) Small farm machinery (lawn and garden tractors, lawn mowers, rototillers, etc.);

(c) Small appliances (fans, mixers, blenders, crock pots, dehumidifiers, vacuum cleaners, etc.);

(d) Commercial machinery (office equipment, computers and auxiliary equipment, typewriters, calculators, vending machines, etc.);

(e) Industrial machinery (pumps, compressors, conveyor components, fans, blowers, transformers, etc.);

(f) Fabricated metal products (metal covered doors, frames, etc.); and

(g) Any other industrial category which coats metal parts or products under the Standard Industrial Classification Code of Major Group 33 (primary metal industries), Major Group 34 (fabricated metal products), Major Group 35 (nonelectric machinery), Major Group 36 (electrical machinery), Major Group 37 (transportation equipment), Major Group 38 (miscellaneous instruments), and Major Group 39 (miscellaneous manufacturing industries).

(5) This rule does not apply to the surface coating of the following metal parts and products:

(a) Automobiles and light-duty trucks;

(b) Metal cans;

(c) Flat metal sheets and strips in the form of rolls or coils;

(d) Magnet wire for use in electrical machinery;

(e) Metal furniture;

(f) Large appliances;

(g) Exterior surface areas of airplanes;

(h) Automobile refinishing;

(i) Customized top coating of automobiles and trucks, if production is less than 35 vehicles per day;

(j) Marine vessels;

(k) Storage vessels; and

(l) Prime and top coating of aerospace components.

(6) The owner or operator of a coating operation subject to this rule shall:

(a) Meet the applicable increments of progress in the following schedule:

(1) Submit final plans for the emission control technique before April 1, 1986,

(2) Achieve final compliance before December 31, 1986, and

(b) Certify to the Technical Secretary within 20 days after each deadline for each applicable increment of progress whether the required increment has been met.

(7) Proof of compliance with the standards of this rule shall be provided by:

(a) Methods approved by the Technical Secretary and consistent with:

1. EPA Guideline Series document, "Measurement of Volatile Organic Compounds," EPA-450/2-78-041,

2. Appendix A of "Control of Volatile Organic Emissions from Existing Stationary Sources - Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks," EPA-450/2-77-008, and

3. Rules 1200-3-18-.43, .44 and .45,

(b) Certification by the manufacturer of the composition of coatings, if supported by batch formulation records and approved by the Technical Secretary, may be accepted as the coatings analyses, and

(c) Monitoring of process equipment and emission control equipment as required by the Technical Secretary to confirm continued compliance.

Authority: TCA 53-3412.

APPENDIX B. ENFORCEMENT ASPECTS

Determination of compliance with the recommended requirements for the coating of miscellaneous metal parts requires that the facility provide well-documented reports of the VOC content and amount of each coating used. Information provided should include the name or number as well as the supplier of each coating. Coaters should also report the amount of solvents used per year as well as the purpose for solvent usage. Each facility should explore the availability of compliant coatings for each specific application.